Original Article

Prevalence of Modic Changes in Cervical Spine and Their Association with Disc Herniation

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ABSTRACT

Objective: To evaluate the prevalence of Modic changes (MCs) in the cervical spine and their association with disc herniations (DH).

Study Design: A retrospective study

Place and Duration of Study: This study was conducted at the Department of Radiology, Ch. Pervaiz Elahi Institute of Cardiology Multan from 4th March 2021 to 4th March 2022.

Materials and Methods: A total of 250 patients elder than 50 years old were included in the study. The cervical MRI scans of these patients were analyzed for prevalence, location and category of MCs and DH. 100 scans among these scan images were assessed by an independent observer (medical intern) for interobserver reliable diagnosis and this observer evaluated the scans after 30 days again for intraobserver reliability.

Results: Only 215 participants were selected for final analysis among which Modic changes were found in 85 (39.5%). MCs type 1was less observed (3.5%) while type 2 was dominant (10.5%). DH were observed in 170 participants (79%). Both MCs and DH were mostly found at C5/6 and C6/7 discs. Modic changes and disc herniations were positively related (risk ratio=2.3). The intraobserver reliability was perfect (k= 0.78) and the interobserver reliability was upper-moderate (k=0.49).

Conclusion: Majority of patients showed Modic changes, mostly types two were seen in the cervical region, frequently in C5/6 and C6/7. MCs and DH were found in patients at the same level.

Key Words: Modic changes, disc herniation, bone marrow, bone marrow oedema, cervical spine

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INTRODUCTION

Modic et al. first observed and categorized Modic changes in the dehydrated lumbar intervertebral disc in MR [1, 2]. According to him, Modic changes can be classified into three categories naming types 1, 2 and 3. He observed that 4% of patients had type 1 MCs and is associated with inflammation and bone marrow lesions[3]. Type 2 changes were most frequently found and represent increased fat mass index and a decreased inflow of blood in the infected bone marrow [4-6]. Type 3 MCs are the least common and reflect an increase in bone formation in the affected spine or subchondral sclerosis. Modic changes are associated with low back pain (LBP) and these lesions can be seen on magnetic resonance imaging scans[7].

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Most of the studies conducted related to Modic changes address the changes in the lumbar spine while one study, studied these changes in the neck region[8]. Due to limited literature on this subject, our study was conducted to study the prevalence, category and location of Modic changes in the cervical spine in a relatively large sample and compare the results with the already conducted study. We also assessed other processes during spine degeneration such as disc herniation and the association between disc herniation and Modic changes was evaluated as it had not been covered by the previous study. In addition, no study to date has reported the reliability scores in the identification of Modic changes in the cervical spine, this study aims to assess the prevalence and categorization of MCs in the cervical spine, the reliability scores and the association of marrow Modic changes and disc herniations.

MATERIALS AND METHODS

A retrospective study was conducted from 4th Mar 2021 to 4th Mar 2022 at the department of Radiology of Ch.Pervaiz Elahi Institute of Cardiology Multan.

A total of 250 patients elder than 50 years old were included in the study. The cervical MRI scans of these patients were used for analysis obtained from the radiology department. The patients who recently had

acute vertebral fractures, congenital bock vertebrae, hemodialysis spondyloarthropathy, spinal infections or tumours, surgical fusions, inflammatory spondy-loarthropathy, acute traumatic Schmorl's nodes, and who had undergone radiotherapy were excluded from the study. All the patients provided their informed written consent to be a part of the study. The study was approved by the ethics committee of the hospital.

The consecutive MRI scans of 250 patients were selected for evaluation by one observer. A hundred scans were assessed by an independent second observer for an interobserver reliable diagnosis. These hundred patients were evaluated again by this observer after 30 days for intraobserver reliability. An expert radiologist and a medical intern, expert in understanding and evaluating the cervical MRI scans independently assessed the T1- and T2-weighted axial and sagittal scan images. Both the experts reported the scan characteristics by consensus and by following the standards in the literature. These standards were decided by both observers by initially assessing sample scan images.

Each patient was analyzed for age, sex, the existence of Modic changes, the dominant type of Modic changes and the segment level of MCs. Since type 3 is not common, only types 1 and 2 were evaluated. In addition, MCs are not common in the cervical region, only the motion segments C3/4, C4/5, C5/6, and C6/7 were assessed. While evaluating disc herniation, their type, appearance or non-appearance and segmental disc level were noted. Herniation was classified according to the interpretation by the radiologist. Disc herniation type 1 was regarded as bulging of the disc without compromising the spinal cord or nerve root, type 2 was reported as bulging of the outer annulus while compromising the spinal cord or nerve root. Axial and sagittal MRI scans were analyzed for figuring out the categorization and location of the disc herniation.

All the data were analyzed by using SPSS version 25. The presence of Modic changes and disc herniation was calculated based on the number of patients and the number of affected discs. Reliability scores were calculated by Cohen's Kappa statistics. A k value of 0.77-1.00 showed perfect reliability, while a value of 0.15 or less indicated poor reliability.

RESULTS

Only 215 were selected for final analysis as they were according to the inclusion criteria. The patients were elder than 50 years but not more than 85 years, the average age being 60.6 (SD± 8.72). A total of 850 motion segments were assessed, out of which 119 (14%) showed Modic changes and 30 (3.5%) were MCs type 1 and 90 (10.5%) were type 2. 30 (13.9%) patients had Modic changes in more than one segment. Modic changes were mostly observed in C6/7 and C5/6, 40 cases (33.6%) and 39 cases (32.8%) respectively.

Disc herniation was observed in 170 (79%) patients and 120 (55.8%) patients had herniation in more than one segment. Out of 850 motion segments, 112 (13.2%) had type 1 disc herniation and 238 (28%) had type 2 herniation. Herniations were frequent in C5/6 (35 type 1 and 75 type 2) and C6/7 (33 type 1 and 69 type 2). (Table I)

The association between Modic changes and disc herniation was shown through the risk ratio in Table II. As both existed at the same segment level, the risk ratio was 2.34(95%Cl: 1.86-2.95).

Seventy MRI scans were assessed by both observers (30 were excluded due to criteria) who could not see each other's results. The intraobserver reliability was almost perfect (k= 0.78) and the interobserver reliability was upper-moderate (k=0.49).

Table No.1: Prevalence of MCs and DHs in cervical spine

Abnormality	No of patients (n=215)	No of cervical motion segments (n=850)
Modic change		
Both types, n(%)	85 (39.5%)	119 (14%)
Type 1, n (%)	32 (14.4%)	30 (3.5%)
Type 2, n (%)	60 (28%)	90 (10.5%)
Patients with MC in more than one segment, n (%)	30 (13.9%)	-
Disc herniation		
Both types, n(%)	170 (79%)	350 (41.2%)
Type 1, n(%)	-	112 (13.2%)
Type 2, n(%)	-	238 (28%)
For patients with DH in more than one motion segment, n (%)	120 (55.8%)	-

Table No.2: Risk Ratios of Disc Herniation in Motion Segments with Modic Changes

Motion segment	Risk ratio	95% Cl
C3/4	2.55	1.58-4.99
C4/5	2.90	1.75-5.97
C5/6	1.49	0.98-2.25
C6/7	2.19	1.45-3.25
Pooled (C3/4-C6/7)	2.34	1.86-2.95

DISCUSSION

A high prevalence of Modic changes was observed in the cervical spine, especially in C5/6 and C6/7. These results were consistent with other studies based on cervical regions and this may be due to the same age group of patients i.e. elder than 50 years[8, 9]. The presence and absence of MCs did not relate to the gender or age of the patients. Due to the elderly population, MCs type 2 was more predominant than type 1. The previous study on this subject, however, showed different results in which type of MCs was more common and elderly people were most affected. This study had a large study size and patients with a less average age[8]. The disagreement between results may be due to the inclusion of a wider age group in the study[10].

The majority of the patients also showed disc herniations, both type 1 and 2 (79%). This is due to the high mean age of the patients and the patients included may have severe orthopaedic conditions. Disc herniations were frequently found in C5/6 and C6/7 motion segments. The other studies conducted for studying herniations in the spine have also reported the same results.

The risk ratio was calculated for comparing MCs and DH. The calculations showed that the patients with MCs were twice at risk of being affected by herniation at the same segment than patients with no modic changes. This can be seen in Table 2, although the 95% Cl score range is wide due to the small sample size. An association was found between MCs and disc herniation on the same segment. Jensen et al[11] reported the same results who observed an association between Modic changes and disc herniations in the spinal region. But the reason for this association in the same segment could not be known, which may be due to genetic disposition in study patients [12-14].

The reliability score of the present study was good and consistent with similar studies on the lumbar spine. This is quite encouraging as one observer was just a medical intern who received basic training on reading a scanned image and was reported about relevant literature. The radiologist can use the results of our study and quickly learn to characterize Modic changes and their effects.

Our study has some limitations. The inclusion of older patients affected the results such as a reduction in type 1 Modic changes. The patients included were mostly suffering from complex orthopedic conditions. Intensity inhomogeneity may also be observed in the MRI scans, altering the results which are crucial for assessing disc herniation.

CONCLUSION

Majority of patients showed Modic changes, mostly types two were seen in the cervical region, frequently in C5/6 and C6/7. MCs and DH were found in patients at the same level.

Author's Contribution:

Concept & Design of Study:	Hira Bushra
Drafting:	Riffat Kamal
Data Analysis:	Ayesha Zafar
Revisiting Critically:	Hira Bushra, Riffat Kamal
Final Approval of version:	Hira Bushra

Conflict of Interest: The study has no conflict of interest to declare by any author.

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